



OPERATING MANUAL

MODEL 1740A OSCILLOSCOPE

HEWLETT-PACKARD COMPANY/COLORADO SPRINGS DIVISION
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SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.

GROUND THE INSTRUMENT.

To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three-conductor ac power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE.

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

KEEP AWAY FROM LIVE CIRCUITS.

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.

DO NOT SERVICE OR ADJUST ALONE.

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

USE CAUTION WHEN EXPOSING OR HANDLING THE CRT.

Breakage of the Cathode-ray Tube (CRT) causes a high-velocity scattering of glass fragments (implosion). To prevent CRT implosion, avoid rough handling or jarring of the instrument. Handling of the CRT shall be done only by qualified maintenance personnel using approved safety mask and gloves.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT.

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.

DANGEROUS PROCEDURE WARNINGS.

Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.

WARNING

**Dangerous voltages, capable of causing death, are present in this instrument.
Use extreme caution when handling, testing, and adjusting.**

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SECTION I

GENERAL INFORMATION

1-1. INTRODUCTION.

1-2. The Hewlett-Packard Model 1740A is a dual-channel, 100-MHz, delayed sweep oscilloscope designed for general-purpose bench or field use. The dual-channel vertical deflection system has 12 calibrated deflection factors from 5 mV/div to 20 V/div. Input impedance is selectable (50 ohms or 1 megohm) to meet various measurement requirements. The horizontal deflection system has calibrated sweep rates from 2 s/div to 0.05 μ s/div and delayed sweep rates from 20 ms/div to 0.05 μ s/div. A 10X magnifier expands all sweeps by a factor of 10 and extends the fastest sweep to 5 ns/div. In alternate or chop modes, the trigger-view control feature will display three signals: channel A, channel B, and trigger signal. This allows correlation of the time between the trigger signal and the channel A and channel B signals. With the A VS B control, an X-Y mode of operation is possible. The channel A input (Y-axis) is plotted versus the channel B input (X-axis).

1-3. This manual contains installation and operating instructions, as well as maintenance information for the Model 1740A. Instrument specifications and procedures for verifying proper operation are included. Procedures are also included for adjusting the instrument to its performance specifications. Schematic diagrams, the theory of operation, and troubleshooting information are provided for use in maintaining the instrument.

1-4. This section of the manual contains the performance specifications for the Model 1740A, and a list of the options available. It also lists the accessories supplied with the Model 1740A and other accessories that are available. Instrument and manual identification information are also included.

1-5. SPECIFICATIONS.

1-6. Table 1-1 is a complete list of the Model 1740A critical specifications that are controlled by tolerances. Table 1-2 contains general information that describes operating characteristics of the Model 1740A.

1-7. Any change in the specifications due to manufacturing, design, or traceability to the U.S. National Bureau of Standards will be listed on a manual change sheet included with this manual. The manual and manual change sheet supersede all previous information concerning specifications of the 1740A.

1-8. ACCESSORIES SUPPLIED.

1-9. The following accessories are supplied with the 1740A:

- One Blue Light Filter, HP Part No. 01740-02701
- One Front-panel Cover, HP Part No. 5040-0516
- One Accessory Storage Pouch, HP Part No. 1540-0292
- Two 10:1 Divider Probes, HP Model No. 10006D

1-10. ACCESSORIES AVAILABLE.

1-11. The following accessories are available for the 1740A:

- Model 10002A 50:1 Divider Probe
- Model 10004D 10:1 Divider Probe
- Model 10007B 1:1 Divider Probe
- Model 10020A Resistive Divider Probe Kit (Division ratios of 1:1, 5:1, 10:1, 20:1, 50:1, and 100:1)
- Model 10173A: RFI Metal Mesh Contrast Screen
- Model 10140A: Collapsible Viewing Hood
- Model 197A: Oscilloscope Camera (Requires a Model 10376A Adapter for mounting on 1740A)
- Models 1001A, 1002A, and 1114A: Testmobiles (All accept the Model 1740A and provide mobile stands for the oscilloscope)

1-12. OPTIONS.

1-13. The options listed below extend the usefulness of the Model 1740A.

OPTION 001. Option 001 replaces the standard detachable power cord with a captive power cord. There are two standard options available that install a special CRT in the standard instrument. The only difference between the optional CRT and the standard CRT is the phosphor used in the CRT. Option 007 uses P7 phosphor and Option 011 uses P11 phosphor.

OPTION 090. This option omits the two Model 10006D divider probes normally supplied as accessories. Other probes listed under Accessories Available, which are more suitable, may be specified.

OPTION 101. Option 101 is designed for optimum performance with the HP Model 1607A Logic State Analyzer to provide both digital logical state and analog electrical analysis. (Refer to Section IV for circuit details and Section VI for a list of replaceable parts in Option 101.)

OPTION 102. Option 102 is Option 101 with an additional special adapter plate (HP Part No. 5061-1213). The special adapter plate is used to attach the 1740A and 1607A instruments together as a single unit.

OPTIONS 900 - 903. Options 900 through 903 are special cord options. The connector configurations are shown in Section II of this manual.

1-14. INSTRUMENT AND MANUAL IDENTIFICATION.

1-15. Instrument identification by serial number is located on the rear panel. Hewlett-Packard uses a two-section serial number consisting of a four-digit prefix and a five-digit suffix, separated by a letter

designating the country in which the instrument was manufactured. (A = U.S.A; G = West Germany; J = Japan; U = Unit Kingdom.)

1-16. This manual applies to instruments with a serial prefix number as shown on the title page. If changes have been made in the instrument since this manual was printed, a "Manual Changes" supplement supplied with the manual will define these changes. Be sure to record these changes in your manual. Backdating information in Section VII adapts the manual to instruments with serial numbers lower than that shown on the title page. Part numbers for the manual and the microfiche copy of the manual are also shown on the title page.

Table 1-1. Specifications

VERTICAL DISPLAY MODES

Channel A; channel B; channels A and B displayed alternately on successive sweeps (ALT); channels A and B displayed by switching between channels at an approximate 250 kHz rate with blanking during switching (CHOP); channel A plus channel B (algebraic addition); and trigger view.

VERTICAL AMPLIFIERS (2)

Bandwidth and Rise Time at all deflection factors from 0°C to +55°C.

BANDWIDTH: 3 dB down from 6 div reference signal.

DC-Coupled: dc to 100 MHz in both 50Ω and 1 MΩ input modes.

AC-Coupled: approx 10 Hz to 100 MHz; 1 Hz with 10:1 divider probes.

BANDWIDTH LIMIT: limits upper bandwidth to approx 20 MHz.

RISE TIME: ≤3.5 ns, measured from 10% to 90% points of a 6 div input step.

DEFLECTION FACTOR

Ranges: 5 mV/div to 20 V/div (12 calibrated positions) in 1, 2, 5 sequence, accurate within 3%.

Vernier: continuously variable between all ranges, extends maximum deflection factor to at least 50 V/div. UNCAL light indicates when vernier is not in the CAL position.

POLARITY: channel B may be inverted, front panel pushbutton.

DELAY LINE: input signals are delayed sufficiently to view leading edge of input pulse without advanced trigger.

INPUT COUPLING: selectable AC or DC, 50Ω (dc), or ground. Ground position disconnects input connector and grounds amplifier input.

INPUT RC (selectable)

AC or DC: 1 MΩ ±2% shunted by approx 20 pF.

50 Ohm: 50Ω ±3%; SWR ≤1.4 at 100 MHz on all ranges.

MAXIMUM INPUT

AC or DC: 250 V (dc + peak ac) or 500 V p-p at 1 kHz or less.

50 Ohm: 5 V rms.

A+B OPERATION

Amplifier: bandwidth and deflection factors are un-

changed; channel B may be inverted for A—B operation.

Differential (A—B) Common Mode: CMRR is at least 20 dB from dc to 20 MHz. Common mode signal amplitude equivalent to 8 divisions with one vernier adjusted for optimum rejection.

VERTICAL MAGNIFICATION (X5)

BANDWIDTH: 3 dB down from 8 div reference signal.

DC-Coupled: dc to approx 40 MHz.

AC-Coupled: approx 10 Hz to 40 MHz.

RISE TIME: ≤9 ns (measured from 10% to 90% points of 8 div input step).

DEFLECTION FACTOR: increases sensitivity of each deflection factor setting by a factor of 5 with a maximum sensitivity of 1 mV on channels A and B.

TRIGGER SOURCE

Selectable from channel A, channel B, composite, or line frequency.

CHANNEL A: all display modes triggered by channel A signal.

CHANNEL B: all display modes triggered by channel B signal.

COMPOSITE: all display modes triggered by displayed signal except in Chop. In Chop mode, trigger signal is derived from channel A.

LINE FREQUENCY: trigger signal is derived from power line frequency.

TRIGGER VIEW

Display internal or external trigger signal in Alternate or Chop mode, channel A, channel B, and the trigger signals are displayed. In channel A or B mode, Trigger View overrides that channel. Internal trigger signal amplitude approximates vertical signal amplitude. Ext trigger signal deflection factor is approx 100 mV/div or 1 V/div in EXT ×10. Triggering point is approx center screen. With identically timed signals to a vertical input and the Ext trigger input, trigger signal delay is 2.5 ns ±1 ns.

HORIZONTAL DISPLAY MODES

Main, main intensified, mixed, delayed, mag X10, and A vs. B.

Table 1-1. Specifications (Cont'd)

MAIN AND DELAYED TIME BASES**RANGES**

Main: 50 ns/div to 2 s/div (24 ranges) in 1, 2, 5 sequence.

Delayed: 50 ns/div to 20 ms/div (18 ranges) in 1, 2, 5 sequence.

Accuracy

Sweep Time/Div	*Accuracy		Temp Range
	X1	X10	
50 ns to 20 ms	±3%	±4%	0°C to +15°C
	±2%	±3%	+15°C to +35°C
	±3%	±4%	+35°C to +55°C

*Add 1% for 50 ms to 2 s ranges.

MAIN SWEEP VERNIER: continuously variable between all ranges, extends slowest sweep to at least 5 s/div. UNCAL light indicates when vernier is not in CAL position.

MAGNIFIER (X10): expands all sweeps by a factor of 10, extends fastest sweep to 5 ns/div.

CALIBRATED SWEEP DELAY

DELAY TIME RANGE: 0.5 to 10 X Main Time/Div settings of 100 ns to 2 s (minimum delay 150 ns).

DIFFERENTIAL TIME MEASUREMENT ACCURACY

Main Time Base Setting	*Accuracy (+15°C to +35°C)
100 ns/div to 20 ms/div	±(0.5% + 0.1% of full scale)
50 ms/div to 2 s/div	±(1% + 0.1% of full scale)

*Add 1% for temperatures from 0°C to +15°C and +35°C to +55°C.

DELAY JITTER: <0.002% (1 part in 50 000) of maximum delay in each step from +15°C to +35°C; <0.005% (1 part in 20 000) from 0°C to +15°C and +35°C to +55°C.

TRIGGERING**MAIN SWEEP**

Normal: Sweep is triggered by internal or external signal.

Automatic: bright baseline displayed in absence of input signal. Triggering is same as Normal above 40 Hz.

Single: sweep occurs once with same triggering as Normal; reset pushbutton arms sweep and lights indicator.

DELAYED SWEEP (SWEEP AFTER DELAY)

Auto: delayed sweep automatically starts at end of delay.

Trig: delayed sweep is armed and triggerable at end of delay period.

INTERNAL: dc to 25 MHz on signals causing 0.3 divisions or more vertical deflection, increasing to 1 division of vertical deflection at 100 MHz in all display modes (required signal level is increased by 2 when in Chop mode and by 5 when X5 vertical magnifier is used). Triggering on Line frequency is also selectable.

EXTERNAL: dc to 50 MHz on signals of 50 mV p-p or more increasing to 100 mV p-p at 100 MHz (required signal level is increased by 2 when in Chop mode).

EXTERNAL INPUT RC: approx 1 MΩ shunted by approx 20 pF.

MAXIMUM EXTERNAL INPUT: 250 V (dc + peak ac) or 500 V p-p ac at 1 kHz or less.

LEVEL and SLOPE

Internal: at any point on the positive or negative slope of the displayed waveform.

External: continuously variable from +1.5 V to -1.5 V on either slope of the trigger signal, +15 V to -15 V in divide by 10 mode (÷10).

COUPLING: AC, DC, Main LF REJ, or Main HF REJ.

AC: attenuates signals below approx 20 Hz.

LF Reject (Main Sweep): attenuates signals below approx 4 kHz.

HF Reject (Main Sweep): attenuates signals above approx 4 kHz.

TRIGGER HOLDOFF (Main Sweep): increases sweep holdoff time in all ranges.

CALIBRATED MIXED TIME BASE

Dual time base in which the main time base drives the first portion of sweep and the delayed time base completes the sweep at the faster delayed sweep. Also operates in single sweep mode. Accuracy, add 2% to main time base accuracy.

A vs. B OPERATION**BANDWIDTH**

Channel A (Y-axis): same as channel A.

Channel B (X-axis): dc to 5 MHz.

DEFLECTION FACTOR: 5 mV/div to 20 V/div (12 calibrated positions) in 1, 2, 5 sequence.

PHASE DIFFERENCE BETWEEN CHANNELS: <3°, dc to 100 kHz.

Table 1-2. General Information

CATHODE-RAY TUBE AND CONTROLS

TYPE: Hewlett-Packard, 12.7 cm (5 in.) rectangular CRT, post accelerator, approx 15 kV accelerating potential, aluminized P31 phosphor.

GRATICULE: 8 X 10 div (1 div = 1 cm) internal, non-parallax graticule with 0.2 subdivision markings on major horizontal and vertical axes and markings for rise time measurements. Internal floodgun graticule illumination.

BEAM FINDER: returns trace to CRT screen regardless of setting of horizontal, vertical, or intensity controls.

Z-AXIS INPUT (INTENSITY MODULATION): +4 V, ≥50 ns width pulse blanks trace of any intensity, usable to ≤10 MHz for normal intensity. Input R, 1 kΩ ±10%. Maximum input ±20 V (dc + peak ac).

REAR PANEL CONTROLS: astigmatism and trace align.

GENERAL

REAR PANEL OUTPUTS: main and delayed gates, 0 V to >+2.5 V capable of supplying approx 5 mA.
AMPLITUDE CALIBRATOR (0°C to +55°C)

Output Voltage	1 V p-p into ≥1 MΩ 0.1 V p-p into 50Ω	±1%
Rise Time	≤0.1 μs	
Frequency	approx 1.4 kHz	

POWER: 100, 120, 220, 240 Vac, ±10%; 48 to 440 Hz; 100 VA max.

WEIGHT: net, 13 kg (28.6 lb); shipping, 15.7 kg (34.6 lb).

OPERATING ENVIRONMENT

Temperature: 0°C to +55°C.

Humidity: to 95% relative humidity at +40°C.

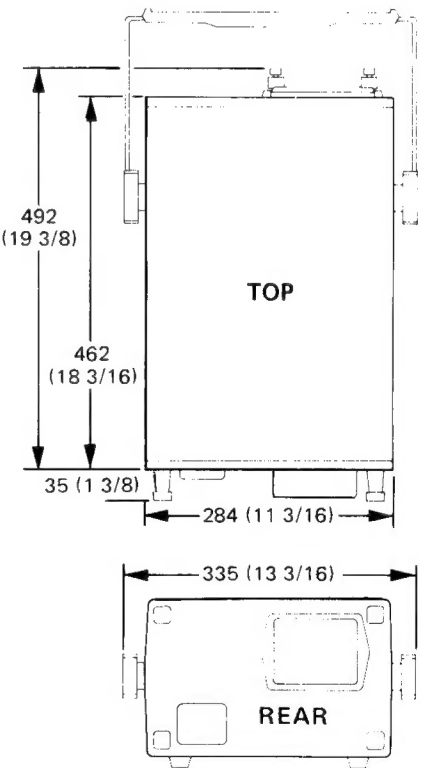
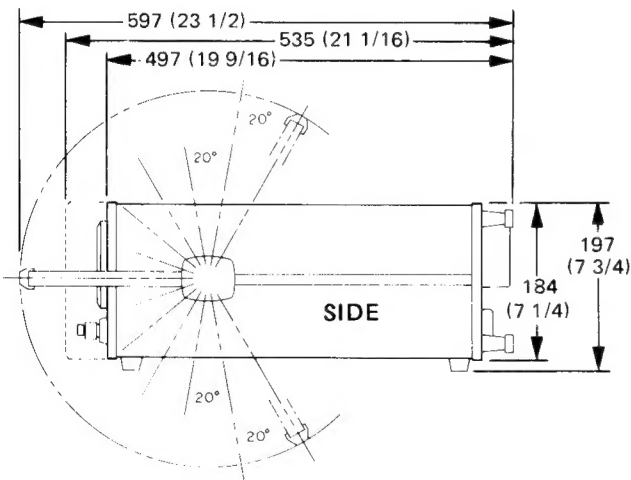
Altitude: to 4600 m (15 000 ft).

Vibration: vibrated in three planes for 15 min. each with 0.254 mm (0.010 in.) excursion, 10 to 55 Hz.

DIMENSIONS: see outline drawing.

NOTES:

- 1. DIMENSIONS ARE FOR GENERAL INFORMATION ONLY. IF DIMENSIONS ARE REQUIRED FOR BUILDING SPECIAL INCLOSURES, CONTACT YOUR HP FIELD ENGINEER.
- 2. DIMENSIONS ARE IN MILLIMETERS AND (INCHES).



SECTION II

INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information and instructions necessary for installing and interfacing the Model 1740A Oscilloscope. Included are initial inspection procedures, power and grounding requirements, installation instructions, and procedures for repackaging the instrument for shipment.

2-3. INITIAL INSPECTION.

2-4. This instrument was carefully inspected both mechanically and electrically before shipment. It should be free of marks or scratches and in perfect electrical order upon receipt. To confirm this, the instrument should be inspected for physical damage incurred in transit. If the instrument was damaged in transit, file a claim with the carrier. Check for supplied accessories (listed in Section I) and test the electrical performance of the instrument using the performance test procedures outlined in Section V. If there is damage or deficiency, see the warranty in the front of this manual.

WARNING

Read the Safety Summary at the front of the manual before installing or operating the instrument.

2-5. POWER CORDS AND RECEPTACLES.

2-6. Figure 2-1 illustrates the standard configuration used for HP power cords. The HP part number directly above each drawing is the part number for an instrument power cord equipped with a connector of that configuration. If the appropriate power cord is not included with the instrument, notify the nearest HP Sales and Service Office and a replacement cord will be provided.

STD-002-07-76

HP POWER CABLE PART NUMBERS			
8120-1692	8120-0696	8120-1703	8120-1521
Option 902	Option 901	Option 900	Option 903
INPUT POWER RECEPTACLE TYPES			

Figure 2-1. Types of Power Source Receptacles and Applicable Input Power Cable Part Numbers

2-7. POWER REQUIREMENTS.

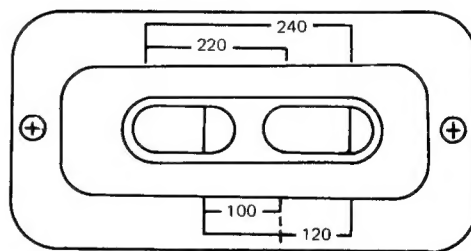
2-8. The 1740A can be operated from any power source supplying 100 V, 120 V, 220 V, or 240 V ($\pm 10\%$), single phase, 48 to 440 Hz. Power dissipation is 100 VA maximum.

CAUTION

Instrument damage may result if line-voltage selection switch is not correctly set for the input power source.

2-9. The instrument is normally set at the factory for 120-volt operation. To operate the instrument from any other ac power source, proceed as follows:

- a. Verify that Model 1740A power cable is not connected to any input power source.
- b. Stand instrument on rear legs. Use a blade-type screwdriver to position line-voltage selection switch through opening in bottom cover. (Figure 2-2 shows switches set for 120-V operation.)
- c. For 220-V or 240-V inputs, replace fuse F1 with 0.5 A slow-blow fuse supplied with instrument.
- d. Connect input power cable to power source.



1740A-200-07-76

Figure 2-2. Line Voltage Selection Switch Settings

2-10. REPACKING FOR SHIPMENT.

2-11. If the instrument is to be shipped to a Hewlett-Packard Sales/Service Office for service or repair, attach a tag showing owner (with address), complete instrument serial number, and a description of the service required.

2-12. Use the original shipping carton and packing material. If the original packing material is not available, the Hewlett-Packard Sales/Service Office will provide information and recommendations on materials to be used.

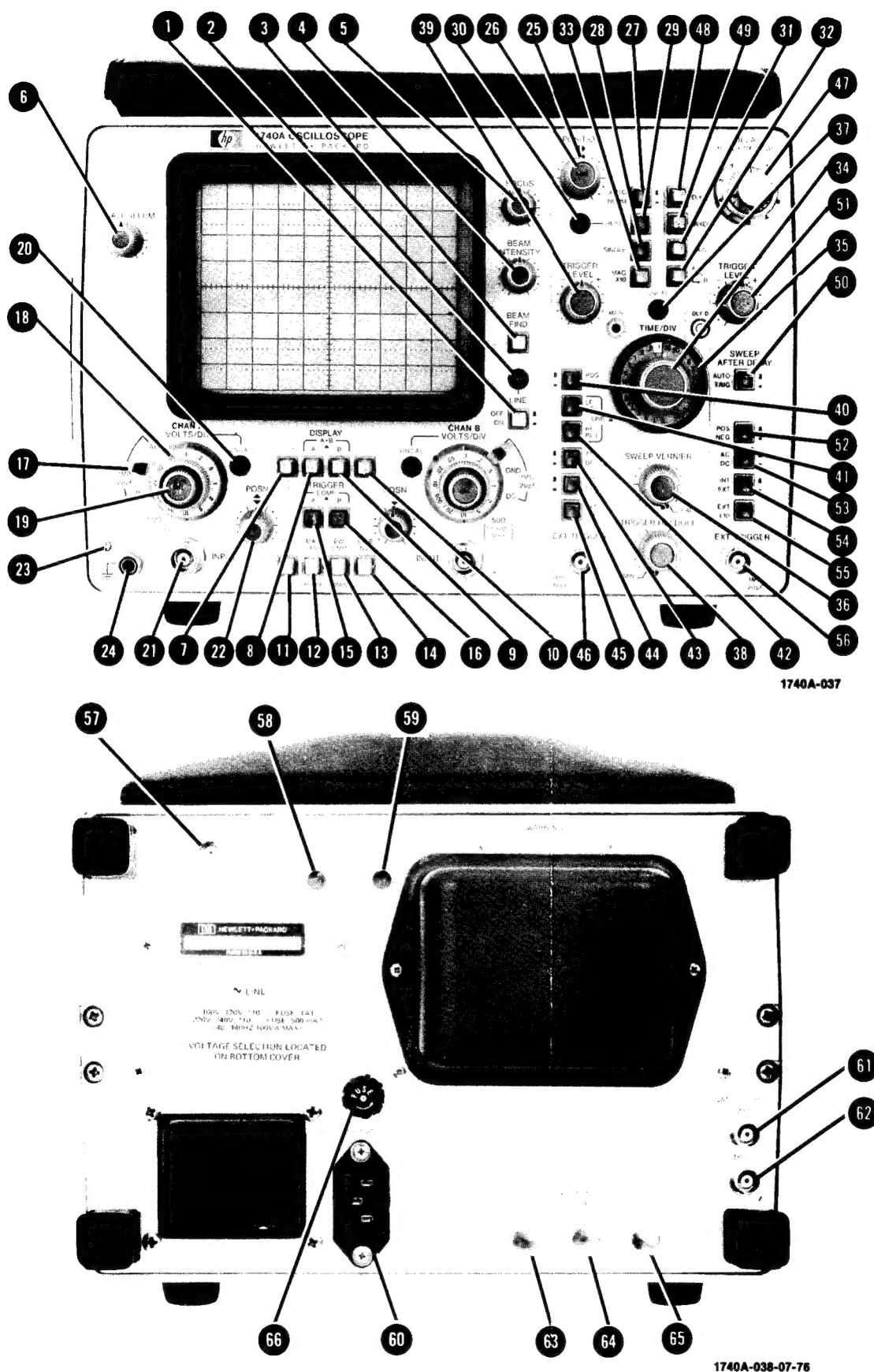


Figure 3-1.
Controls and Connectors
3-0

- 1 LINE. Switches the oscilloscope on and off.
- 2 LINE INPUT. Connects the instrument to the line.
- 3 BEAM FINDER. Increases the brightness of the display when the beam is off.
- 4 BEAM INTENSITY. Controls the intensity of the beam.
- 5 FOCUS. Adjusts the focus of the beam to the sharpest point.
- 6 SCALE ILLUMINATION. Controls the illumination of the scale.
- 7 ALT. Channel A/Channel B. Alternates between Channel A and Channel B.
- 8 Channel A. Channel A signal.
- 9 Channel B. Channel B signal.
- 8 & 9 A+B. Preset for Channel B.
- 10 CHOP. Chopped signal between channels.
- 11 TRIG VIEW. Triggers the view of the signal.
- 12 MAG X5. Magnification of the signal.

- 1 **LINE.** Switch turns instrument power on and off.
- 2 **LINE INDICATOR.** Indicator lights when the instrument power is on.
- 3 **BEAM FIND.** Pressing this pushbutton increases the intensity and compresses the display within the viewing area.
- 4 **BEAM INTENSITY.** Controls the brightness of the CRT display.
- 5 **FOCUS.** Adjusts the writing beam for the sharpest trace. Always keep this display focused to prevent damaging the CRT internally.
- 6 **SCALE ILLUM.** Adjust the CRT background illumination for good contrast between the background and the graticule.
- 7 **ALT.** Channel A and B signals are displayed alternately on consecutive sweeps.
- 8 **Channel A.** Displays the channel A input signal.
- 9 **Channel B.** Displays the channel B input signal.
- 8 & 9 **A+B.** Pressing both channel A 8 and channel B 9 displays the algebraic sum of the channel A and channel B input signals. If the channel B display is inverted (press CH B INVT 14), an A minus B display results.
- 10 **CHOP.** Channel A and B signals are displayed simultaneously by switching between channels at a 250-kHz rate.
- 11 **TRIG VIEW.** Displays the selected internal or external trigger signal at a fixed sensitivity of approximately 100 mV/div or 1 V/div with EXT ÷ 10 45. TRIGGER LEVEL 39 positions the display vertically. Center screen indicates the trigger threshold level with respect to the trigger signal. If ALT 7 or CHOP 10 is selected, three signals are displayed: channel A, the selected trigger signal (at center screen), and channel B.
- 12 **MAG X5.** Magnifies the vertical presentation five times, and increases the maximum sensitivity to 1 mV/div. The bandwidth is decreased to 40 MHz.
- 13 **BW LIMIT.** Reduces the bandwidth of channel A and channel B to approximately 20 MHz.
- 14 **CH B INVT.** Inverts the polarity of the channel B signal. In A+B 8 & 9 mode, pressing CH B INVT 14 results in an A minus B display.
- 15 **TRIGGER A.** Selects a sample of the channel A signal as the trigger signal when INT/EXT 44 is in INT.
- 16 **TRIGGER B.** When in INT, a sample of the channel B signal is selected as the trigger signal.
- 15 & 16 **COMP.** When the display mode is set to channel A, channel B, ALT, or A+B, the sweep is triggered by the displayed signal. When in CHOP, the sweep is triggered by the channel A signal only.
- 17 **AC.** Selects the input coupling and impedance for the vertical amplifiers. In the AC position the dc component of the input signal is blocked. The lower 3-dB limit is approximately 10 Hz.
- GND.** The input signal is disconnected from the amplifier, and the amplifier input is grounded.
- DC.** All elements of the input signal are passed to the vertical amplifier. The input impedance is approximately 1 megohm shunted by 20 pF.
- 50Ω. The input signal is dc coupled, and the input impedance is 50Ω. Pull the lever forward and down to select this position. Do not apply more than 5 V rms to the input connector.
- 18 **VOLTS/DIV.** Selects the vertical deflection factor in a 1, 2, 5 sequence from 0.005 V/div to 20 V/div, accurate within 3% with vernier 19 in the CAL position.
- 19 **Vernier.** Provides continuous control of the deflection factor between calibrated VOLTS/DIV ranges. Vernier range is at least 2.5 to 1.
- 20 **UNCAL.** Lights when the vernier control is out of detent position to indicate VOLTS/DIV is uncalibrated.
- 21 **IN** sig B an th 50
- 22 **PO** dis
- 23 **CA** (w rec kH na
- 24 **GF** cor gro
- 25 & 26 **PO** jus ly.
- 27 **AU** but a b sig NC req gen inp
- 28 **SIN** trig the SE
- 29 **RE** the mo car nal GE
- 30 **Res** circ of trig the
- 31 **MA** disp sele 34

- 21 INPUT.** BNC connector to apply external signals to the channel A (Y) and channel B (X) amplifier. Impedance and coupling are selectable by **17**. Do not apply more than 250 V (dc + peak ac) or more than 500 V p-p ac at 1 kHz or less.
- 22 POSN.** Controls the vertical position of the display.
- 23 CAL 1 V.** Provides a 1-V peak-to-peak (within 1%) square-wave voltage signal recurring at an approximate rate of 1.4 kHz (100 mV peak-to-peak when terminated in 50Ω).
- 24 GROUND POST.** Convenient chassis ground connector. Useful to ensure a common ground with equipment under test.
- 25 & 26 POSITION.** Coarse **25** and FINE **26** adjustments position the display horizontally.
- 27 AUTO/NORM.** AUTO sweep mode (push-button out). A free running sweep provides a bright display in the absence of a trigger signal.
NORM sweep mode (pushbutton in) requires an internal or external signal to generate a sweep and must be used if the input frequency is less than 40 Hz.
- 28 SINGLE.** Sweep occurs once with the same triggering as in NORM. After each sweep, the trigger circuit must be manually RESET **29**.
- 29 RESET.** Momentary pushbutton that arms the trigger circuit in the single-sweep mode. After pressing RESET **29**, the sweep can be triggered by an internal or external trigger signal or by rotating the TRIGGER LEVEL control **39** through zero.
- 30 Reset Lamp.** When lit, indicates the trigger circuit is armed. Lamp goes off at the end of the sweep and remains off until the trigger circuit is again armed by pressing the reset button.
- 31 MAIN.** Selects main sweep for horizontal display. Sweep rate and triggering are selected by the main-sweep controls **25** - **34**, and **36** - **38**.
- 32 A VS B.** Selects an X-Y mode of operation with channel A input (Y-axis) plotted versus channel B input (X-axis). Vertical positioning is adjusted by channel A POSN **22**, and horizontal positioning is adjusted by POSITION **25** and FINE **26**.
- OPTION 101.** Deletes the A VS B function and adds logic state display. When the Model 1740A is connected to a HP Model 1607A Logic State Analyzer, pressing STATE DSPL **32** displays a 16-word table of 16-bit words.
- 33 MAG X10.** Magnifies the horizontal display 10 times, and expands the fastest sweep time to 5 ns/div, maintaining a sweep accuracy within 3% at room temperature.
- 34 MAIN TIME/DIV.** The inner knob controls the main-sweep rate, which is indicated by the numbers displayed in the knob skirt opening. Sweep accuracy is within 2% (unmagnified) at room temperatures.
- 35 DLY'D TIME/DIV.** The outer rotating section selects the delayed-sweep rate, which is indicated by the marker on the outer knob. Sweep accuracy is the same as with MAIN TIME/DIV. An interlock is incorporated so the delayed sweep is always faster than the main sweep. When rotated out of the off position in the MAIN mode **31**, a portion of the main sweep is intensified indicating the length and delay position of the delayed sweep with respect to the main sweep.
- 36 SWEEP VERNIER.** Provides continuous adjustment of main sweep TIME/DIV between calibrated positions, extending the slowest sweep to 5 s/div.
- 37 UNCAL.** Lights when SWEEP VERNIER **36** is out of the CAL detent position, and indicates that the sweep is not calibrated.
- 38 TRIGGER HOLDOFF.** Increases the time between sweeps and aids triggering on complex displays such as digital words.
- 39 & 51 TRIGGER LEVEL.** Selects the voltage level on the input trigger signal where the sweep is triggered. With external trigger signals, the trigger level is continuously variable from +1.5 V to -1.5 V on either slope of the input trigger signal; +15 V to -15 V in EXT ÷ 10 **45** mode. With internal trigger signals, the trigger level selects any point on the vertical waveform displayed.
- 40 & 52 POS/NE** that sel INT **44** sweep.
- 41 LF REJ** trigger s This is signals nating such as
- 42 HF REJ** trigger s This is signals nating such as
- 41 & 42 LINE. S** REJ **42** INT **44** circuit a signal f
- 43 & 53 AC/DC.** input (**44** or **54** DC pos below a
- 44 & 54 INT/EX** nal vert source (signal a put for circuit.
- 45 & 55 EXT ÷ 1** or **56** in
- 46 & 56 EXT TR** trigger mately mately 250 V (1 kHz o
- 47 DELAY.** variable MAIN T
- 48 DLY'D.** tal disp

- 40 & 52 POS/NEG.** Two-position pushbutton switch that selects the slope of the (EXT **44** or INT **44**) trigger signal used to start the sweep.
- 41 LF REJ.** Attenuates internal or external trigger signals below approximately 4 kHz. This is useful to condition high-frequency signals for best synchronization by eliminating unwanted high-frequency signals such as power line interference.
- 42 HF REJ.** Attenuates internal or external trigger signals above approximately 4 kHz. This is useful to condition low-frequency signals for best synchronization by eliminating unwanted high-frequency signals such as RF.
- 41 & 42 LINE.** Selecting both LF REJ **41** and HF REJ **42** removes all EXT **44** input or INT **44** displayed signals from the trigger circuit and applies a power-line frequency signal for triggering.
- 43 & 53 AC/DC.** Selects ac or dc coupling of the input (EXT **44** or **54**) or displayed (INT **44** or **54**) signal to the trigger circuit. The DC position must be selected for signals below approximately 20 Hz.
- 44 & 54 INT/EXT.** INT selects a sample of the internal vertical signal chosen by the TRIGGER source **15** or **16**, while EXT selects the signal at the EXT TRIGGER **46** or **56** input for application to the main trigger circuit.
- 45 & 55 EXT ÷ 10.** Attenuates EXT TRIGGER **46** or **56** input signal by a factor of 10.
- 46 & 56 EXT TRIGGER.** BNC connector for external trigger input. Input impedance is approximately one megohm shunted by approximately 20 pF. Do not apply more than 250 V (dc + peak ac) or 500 V p-p ac at 1 kHz or less.
- 47 DELAY.** The DELAY control provides a variable delay time from 0.5 to 10X the MAIN TIME/DIV settings of 100 ns to 2 s.
- 48 DLY'D.** Selects delayed sweep for horizontal display.
- 49 MIXED.** Selects main and delayed sweeps for the horizontal display. The first portion of the sweep is at the main sweep rate, and the second portion of the sweep (starting point chosen by DELAY **47**) is at the delayed-sweep rate.
- 50 SWEEP AFTER DELAY AUTO/TRIG.** Selects the method of starting the delayed-sweep when in main intensified, delayed, or mixed mode operation. In AUTO, delayed sweep starts immediately after the delay interval, which is the product of the DELAY **47** dial reading (div) and the main TIME/DIV **34** reading. In TRIG, the delayed-trigger circuit is armed after the delay interval and delayed sweep must be triggered by either an internal or external trigger signal.
- 57 Z-AXIS INPUT.** BNC connector for intensity modulation of the CRT display. A +4-volt, ≥50-ns width pulse blanks a trace of any intensity. Do not apply more than ±20 V (dc + peak ac).
- 58 TRACE ALIGN.** Screwdriver adjustment to align the horizontal trace with the graticule.
- 59 ASTIGMATISM.** Screwdriver adjustment used in conjunction with FOCUS **5** to achieve a clean, sharp spot or trace. Adjustment is easier with a stationary spot.
- 60 LINE INPUT.** Connector for the power cord.
- 61 MAIN GATE OUTPUT.** Provides a rectangular output of approximately +2.5 V coincident with the main gate.
- 62 DLY'D GATE OUTPUT.** Provides a rectangular output of approximately +2.5 V coincident with the delayed gate.
- 63 - 65 1607A INPUTS.** Option 101 only.
- 63 HORIZ.** X-axis input from HP Model 1607A.
- 64 VERT.** Y-axis input from HP Model 1607A.
- 65 Z-AXIS.** Intensity input from HP Model 1607A.
- 66 FUSE.** 1 A 250 V SLO-BLO for 100-V or 120-V operation. 0.5 A 250 V SLO-BLO for 220-V or 240-V operation.

SECTION III

OPERATION

3-1. INTRODUCTION.

3-2. This section provides general operating instructions for Model 1740A. Front- and rear-panel controls and connectors are identified and described in figure 3-1. An initial turn-on procedure, operators calibration, trigger selection table, and procedures for obtaining basic displays are also included. The index numbers after control and connector names in the text are keyed to figure 3-1.

3-3. TURN-ON PROCEDURE.

WARNING

Before turning on the oscilloscope, read the safety summary located at the front of this manual.

3-4. To turn on the Model 1740A, perform the following steps:

- a. Turn all control knobs to the 12 o'clock position except verniers 19 and SWEEP VERNIER 36 should be in CAL position; TRIGGER HOLDOFF 38 on MIN. MAIN TIME/DIV 34 fully clockwise.
- b. Verify pushbuttons out except A 8, A 15, and MAIN 31
- c. Press LINE switch 1; LINE indicator 2 should light. After CRT warm up, a free-running trace should be observed near center screen.
- d. Increase (or decrease) BEAM INTENSITY 4 to comfortable viewing level, and adjust FOCUS 5 as necessary for sharpest trace.

3-5. OPERATOR CHECKS.

3-6. A few checks and adjustments may be required to verify that the Model 1740A is operating properly. If the oscilloscope is moved from one electromagnetic environment to another, the trace alignment control may need adjustment to align the horizontal trace with the graticule. Astigmatism and focus controls may need adjustment to obtain the sharpest display. Probe compensation may be required, since total input resistance and capacitance can vary slightly from one oscilloscope to another.

3-7. Adjust trace alignment as follows:

- a. Obtain a display as described in the turn-on procedure.
- b. With vertical POSN control 22, align trace with center graticule line.
- c. With a screwdriver, adjust TRACE ALIGN 58 (on rear panel) for best trace alignment with graticule line.

3-8. Adjust astigmatism and focus as follows:

- a. Select A VS B 32 and lower BEAM INTENSITY 4 to a low level.
- b. Position spot near center of CRT with POSN 22 and POSITION 25 controls.
- c. Adjust FOCUS 5 and ASTIGMATISM 59 (on rear panel) for the smallest round spot.

3-9. Perform probe compensation adjustment as follows:

- a. Connect probe to be compensated to appropriate vertical INPUT connector 21 and the CAL 1 V output 23.
- b. Set VOLTS/DIV 18 to 0.1, MAIN TIME/DIV 34 to 0.2 mSEC, and input coupling 17 to DC.
- c. Adjust main TRIGGER LEVEL 39 for a stable display of the calibrator square-wave voltage. Display should have flat tops. Any distortion in presentation is caused by incorrect probe compensation.
- d. If overshoot or undershoot is present, turn screwdriver adjustment in probe for a flat-top presentation (see figure 3-2).

3-10. Perform vertical accuracy check as follows:

- a. Set controls to positions indicated in turn-on procedure.
- b. Apply CAL 1 V 23 signal to channel A INPUT 21 connector using a BNC to banana plug adapter and a test lead with alligator clips.
- c. Adjust channel A VOLTS/DIV 18 to 0.2 V/div and MAIN TIME/DIV 34 to 0.2 mSEC/div. Square-

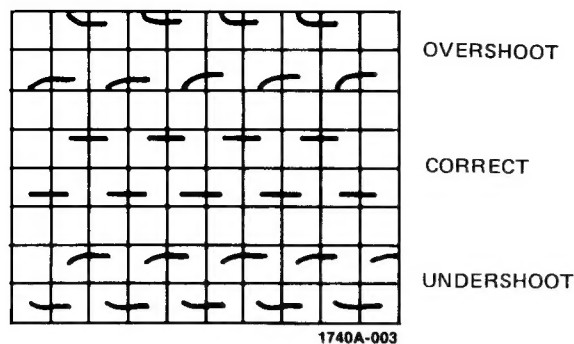


Figure 3-2. Probe Compensation

wave amplitude should be five major divisions within 4%. For complete calibration check, refer to Section V.

3-11. Perform timing accuracy check as follows:

a. Apply an accurate calibration signal (such as from HP Model 226A Time-mark Generator) to the channel A INPUT **21** connector.

b. Set controls to the positions indicated in the turn-on procedure except for MAIN TIME/DIV which should be adjusted to 0.5 μ SEC/div.

c. Set marker on graticule line at far left with horizontal position control. Markers should line up ap-

proximately with each graticule line across the CRT. The marker on the far right-hand side should be within 2 mm of the graticule line.

3-12. TRIGGER SELECTION TABLE.

Table 3-1 will aid in determining the best trigger mode for various signal conditions.

3-13. OBTAINING BASIC DISPLAYS.

3-14. These procedures will aid the operator in becoming familiar with the operation of the Model 1740A so commonly used displays can be obtained. Before performing the procedures, complete the turn-on procedure and adjust the following controls:

Channel A TRIGGER A **15**
 Channel A coupling DC **17**
 Channel A VOLTS/DIV **18** 0.05
 MAIN TIME/DIV **34** 0.5 mSEC
 DELAY **47** fully CCW

3-15. NORMAL SWEEP DISPLAY.

a. Connect a Model 10006D probe to channel A INPUT **21** connector, CAL 1 V **23** output, and ground post **24**.

Table 3-1. Display and Trigger Selection Table

SIGNAL CONDITIONS	DISPLAY MODE	TRIGGER SELECTION			
		A	B	COMP	EXT
I. Single Signals Applied to Channel A or B	A or B	OK	or OK	OK	OK ¹
	ALT ⁵ or CHOP ⁵	OK	or OK	NG	OK ¹
II. Time Related Signals Applied to Channels A & B	ALT	OK²	OK²	NG ³	OK²
	CHOP	OK²	OK²	NG ⁴	OK²
	A+B (A-B)	OK	OK	OK⁶	OK
III. Nontime Related Signals Applied to Channels A & B	ALT	NG	NG	OK	NG

¹ Assume time related signal applied.

² Time relation displayed.

³ No time relation displayed.

⁴ If COMP is selected in CHOP, switching overrides and selects A.

⁵ Signal is only displayed on one channel.

⁶ Triggers on algebraic sum or difference of signals.

OK Useable trigger mode.

OK Good trigger mode.

OK Best trigger mode.

NG Unuseable trigger mode.

b. Adjust POSN 22 to align base of square wave on the center graticule line, and adjust TRIGGER LEVEL 39 for a stable display. A square wave with an amplitude of two divisions and approximately five to nine positive-going pulses will be displayed.

3-16. MAGNIFIED SWEEP DISPLAY.

a. Perform paragraph 3-15 to obtain Normal Sweep Display.

b. Adjust horizontal POSITION 25 to place waveform portion to be magnified on CRT center graticule (see figure 3-3).

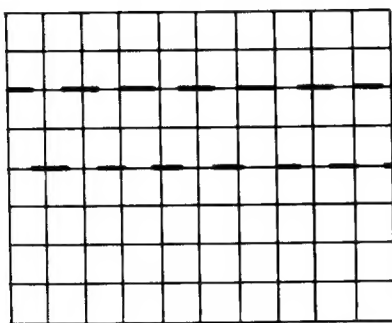


Figure 3-3. Normal Display

c. Press MAG X10 33 and adjust horizontal FINE 26 for precise placement of magnified display (see figure 3-4).

3-17. DELAYED SWEEP DISPLAY.

a. Perform paragraph 3-15 to obtain Normal Sweep Display.

b. Adjust delayed TIME/DIV 35 for 50 μ SEC/div, and observe intensified portion of square wave. Set BEAM INTENSITY 4 control to a comfortable viewing level.

c. Set SWEEP AFTER DELAY to AUTO and turn DELAY 47 clockwise until intensified portion of

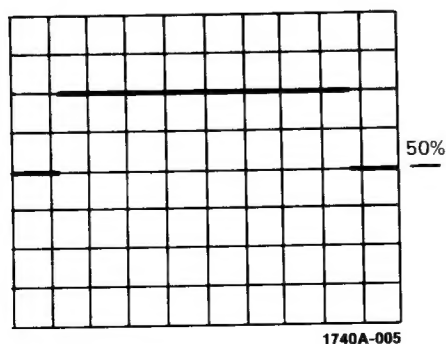


Figure 3-4. Magnified Display

trace is over trace area to be investigated. This is demonstrated in figure 3-5.

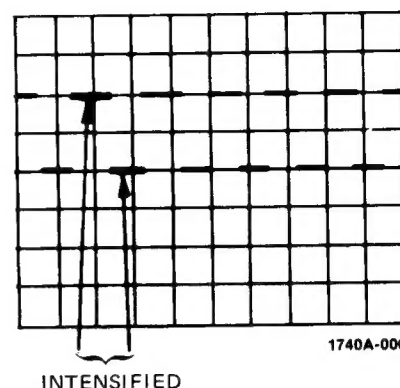


Figure 3-5. Normal Display with Intensified Area

d. Press DLY'D 48 and note that intensified portion of trace is now displayed across entire CRT (see figure 3-6).

e. DELAY 47 control may be adjusted to view other pulses in the pulse train.

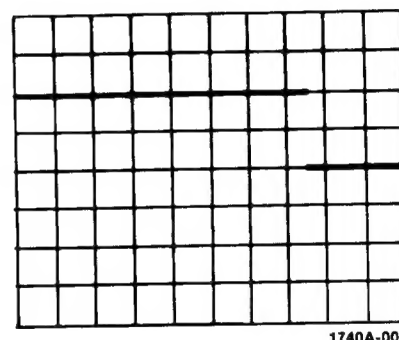


Figure 3-6. Delayed Sweep Display

3-18. MIXED SWEEP DISPLAY.

a. Perform paragraph 3-15 to obtain Normal Sweep Display.

b. Adjust delayed TIME/DIV 35 for 50 μ SEC and note intensified portion of square wave. Set BEAM INTENSITY 4 to comfortable viewing level.

c. Turn DELAY 47 clockwise until part of waveform in second half of CRT is intensified (see figure 3-7).

d. Press MIXED 49 and observe that first portion of the display is at main TIME/DIV 34 sweep rate and second portion is at delayed TIME/DIV 35 sweep rate (see figure 3-8). The transition point from main sweep to delayed sweep can be varied by adjusting DELAY control 47.

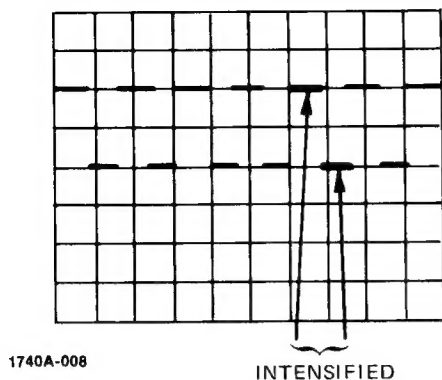


Figure 3-7. Normal Display with Intensified Area

3-19. X-Y DISPLAY.

a. Press A VS B **32**. BEAM INTENSITY **4** may need to be decreased. Apply vertical (Y-axis) signal to channel A INPUT **21** connector and horizontal (X-axis) signal to channel B INPUT connector. Channel A POSN **22** adjusts vertical positioning; POSITION **25** adjust horizontal positioning. Adjust channel A and B VOLTS/DIV **18** controls as required.

b. If display is not visible, press BEAM FIND **3** and adjust channel A and B VOLT/DIV controls until display is compressed vertically. Center compressed display with POSN **22** and POSITION **25**

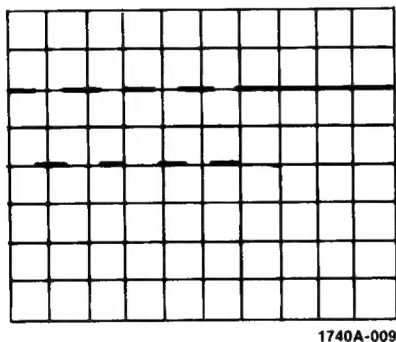


Figure 3-8. Mixed Sweep Display

controls. Release BEAM FIND, and adjust FOCUS **5** for a sharp display.

3-20. SINGLE SWEEP OPERATION.

3-21. Single sweep mode is often used to photograph single occurrence events. To use this mode, proceed as follows:

- Select SINGLE **28** sweep mode.
- Set AUTO/NORM to NORM **27**.
- Set all trigger processing controls to desired settings; for example, INT/EXT **44**, slope **40**, and TRIGGER LEVEL **39**.
- Depress RESET **29** pushbutton; the red RESET **30** lamp will light.

3-22. The sweep circuitry is now armed; as soon as a trigger signal is received that meets the preset requirements (slope, coupling, level, etc.), the time base will generate one sweep. As soon as the sweep ends, the RESET **30** lamp will extinguish and the time base must be reset again.

3-23. SINGLE SWEEP USING TRIGGER VIEW.

3-24. To use the trigger view feature in single sweep, perform the following steps:

- Press TRIG VIEW **11**. This turns off both vertical channels; however, trigger view circuitry will not be activated until a certain transition occurs at the end of the sweep.
- To activate trigger view, press RESET **29** and rotate TRIGGER LEVEL **39** from one extreme to the other or engage AUTO **27** and press RESET, then disengage AUTO.

3-25. After one sweep has been manually generated, the necessary transition will have occurred and trigger view mode will operate in a normal manner.